(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
2 May 2002 (02.05.2002)

PCT

(10) International Publication Number
WO 02/35055 A1

(51) International Patent Classification[7]: E21B 37/02, 27/00

(21) International Application Number: PCT/GB01/04742

(22) International Filing Date: 26 October 2001 (26.10.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0026460.6 27 October 2000 (27.10.2000) GB

(71) Applicant *(for all designated States except US)*: **SPS-AFOS Group Limited** [GB/GB]; Arnhall Business Park, Westhill, Aberdeen AB32 6TQ (GB).

(72) Inventor: **TELFER, George**; 19 Grosvenor Place, Aberdeen AB25 2RE (GB).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **HOWLETT, Paul, David** [GB/GB]; 234 North Deeside Road, Cults, Aberdeen AB15 9PB (GB).

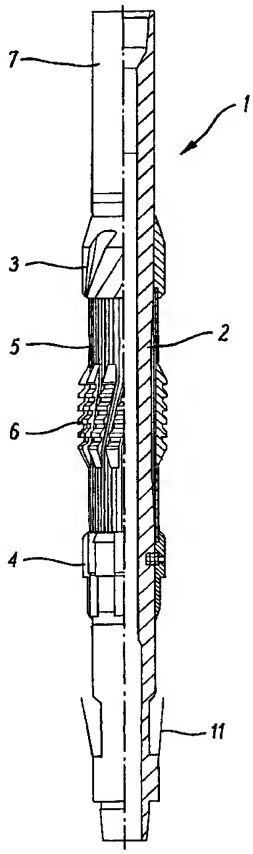
(74) Agent: **KENNEDYS PATENT AGENCY LIMITED**; Floor 5, Queens House, 19 St. Vincent Place, Glasgow G1 2DT (GB).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian

[Continued on next page]

(54) Title: COMBINED MILLING AND SCRAPING TOOL



(57) Abstract: A downhole tool (1) for providing the dual role of cleaning and milling within a wellbore casing or liner is described. In an embodiment scraper blades (6) are mounted on a body (2) together with a milling sleeve (4). Additionally, a centraliser sleeve (3) is incorporated as is a filter and/or junk basket for collecting debris is dislodged from the casing or liner during the cleaning and milling operation. The milling sleeve (4) can be locked onto the body (2) while the cleaning members e.g. scraper blades (6) may be free floating around the tool (1).

WO 02/35055 A1

patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Combined Milling and Scraping Tool

The present invention relates to a combined milling and cleaning tool intended for use in downhole environments.

It is a common procedure during the completion of a well to line the newly drilled bore with casing or liner, the latter typically being used near the production area of the bore. Casing, which is usually made of heavy steel piping, is used to prevent collapse of newly drilled bore segments and contamination of the oil or gas reservoir contained therein. Typically the casing or liner is run into the bore from the surface and held in place by introducing cement between the external surface of the casing or liner and the internal surface of the wellbore, with each section of the bore being drilled with consecutively smaller drill bits and then lined with proportionately smaller casing or liner sections.

It will be appreciated that after cementing the casing or liner in place, it is often necessary to clean the interior of the casing or liner to remove obstructions such as burrs or lumps of cement which remain within the tubing after the cementing procedure. A commonly used

cleaning tool, well known to the art, is a casing scraper which incorporates blades typically made of a resilient material such as steel. The blades are used to scrape the interior surface of the casing or liner.

Milling tools are also well known in the art and are used to "dress off" the polished bore receptacle liner top in a new wellbore. Milling removes burrs, and grinds the polished bore receptacle to allow smooth and easy entry of subsequent tools through the liner. Milling tools are also commonly used to remove casing present in a wellbore if said casing is damaged in any way. Milling tools provide a cutting or grinding action and are necessarily formed from a material which is hard enough to cut or grind the liner top, which is a machine steel tube. Often, the tool is produced with carbide inserts as this material is hard enough to mill casing or liner steel.

Historically when completing a bore using a scraper and milling tool, the scraping tool is run into the wellbore on a work string to clear the interior of the casing. This first tool must then be removed or "tripped" from the bore before the milling tool can be run to tidy up or "dress off" the liner top. As a consequence, the cost and time taken to finish the bore is increased as it is necessary to perform two trips down the well.

Previous attempts to run milling tools and scrapers into a wellbore at the same time have encountered problems, as it is usual for the combined milling and scraping action to dislodge and create additional debris within the casing and liner. This is typically suspended in the well fluid in the bore and negates much of the cleaning which is carried out. It has therefore still been

necessary when carrying out a combined operation to run a second trip down the well to clean the wellbore before production is commenced.

It would be very desirable to be able to run a cutting and a milling tool together in one operation, eliminating at least one trip into and out of the borehole to finish said bore, as the beginning of profitable production will not be delayed.

It is an object of the present invention to provide an improved tool for use when completing a downhole wellbore. In particular is an object of the present invention to provide a tool, which can carry out milling and scraping functions at the same time.

According to the present invention there is provided a downhole tool for mounting on a work string, wherein the tool comprises an elongate body having a plurality of cleaning members, and wherein the tool also comprises means for milling casing or liner.

Preferably the tool also comprises means for cleaning well fluid.

Optionally said means for cleaning well fluid is a junk basket.

Alternatively said means for cleaning well fluid may be filtration equipment.

Typically the cleaning members are scraper blades.

In the preferred embodiment the tool has a first and second sleeve.

Preferably the first sleeve acts as a stabiliser for the work string withir the wellbore.

Preferably the second sleeve is a milling sleeve.

Preferably the tool has a floating component located between said first and second sleeve, wherein the floating component is free to move in a radial direction relative to the elongate body within predetermined limits set by the first and second sleeve.

Preferably the first and second sleeve have female receiving means for receiving the floating component.

Typically the plurality of cleaning members are supported on the floating component.

Preferably the centraliser sleeve is mounted by ball bearings that allow for the work string to rotate relative to the sleeve.

Preferably the milling sleeve is mounted by one or more lock studs that lock the milling sleeve both axially and rotationally with respect to the elongate body.

Example embodiments of the invention will now be illustrated with reference to the following figures in which:

Figure 1 shows a cross-section of a combined scraping and milling tool in accordance with the present invention; and

Figure 2 is a close-up of the locking system, which fixes the milling sleeve to the combined scraping and milling tool shown in Figure 1.

Figure 3 shows a cross-section of a combined scraping and milling tool having a junk sub.

Referring firstly to Figure 1, the combined scraping and milling tool is generally depicted at 1. The tool 1 comprises an elongate body 2 having a first upper 3 and second lower 4 sleeve, and is run into a wellbore (not shown) which is lined by casing and liner, mounted on a work string 7.

The upper 3 sleeve of the tool 1 acts as a centraliser to maintain the tool 1 or work string 2 in a central position within the wellbore, whilst the lower sleeve 4 is a milling sleeve. Typically the milling sleeve is comprised of carbide inserts which are impregnated into a steel sleeve, which are hard enough to mill or grind the liner top in the wellbore. On rotation of the work string the milling sleeve 4 smooths the entrance to the liner top polished bore receptacle.

The tool 1 also comprises a floating component 5 between the upper 3 and lower 4 sleeve. The floating component is a lantern which supports a plurality of scraper blades 6. The scraper blades 6 scrape the casing which is near to and directly above the polished bore receptacle. It will be appreciated from Figure 1 that the scraper blades

are mounted in close proximity to where milling of the liner top takes place.

Figure 2 shows a section of the locking system which holds the milling sleeve 4 to the tool 1 in more detail. The locking system consists of three components, namely a hex-head grub screw 8, a lock stud 9 and PTFE plug 10. The lock stud is cylindrical and flat milled on one side. To mount the milling sleeve 4 on the elongate body 2, the lock stud 9 and grub screw 8 are assembled together flush, and inserted into corresponding holes milled in the elongate body 2 of the tool 1. The milling sleeve 4 is then slipped over the body 2 and secured by screwing down the grub screws 8. The lock studs 9 move rotationally by virtue of the screwing of the grub screws 8, and as a consequence the lock studs 9 back out into drilled countersunk holes in the milling sleeve 4 which locks the sleeve 4 both axially and rotationally with respect to the elongate body 2. As a consequence, the milling sleeve 4 has no or negligible rotational movement, notwithstanding rotation of the work string. A PTFE plug 10 is then inserted into the hole in the body 2 to act as a debris barrier.

The first upper sleeve 3 which centralises the work string 7 in the wellbore is mounted on the elongate body 2 by ball bearings which allow said upper sleeve 3 to rotate relative to the body 2.

It can be seen from Figure 2 that the lantern 5 which supports the scraper blades sits within a recess in the lower milling sleeve 4. A corresponding recess (not shown) is located on the upper centraliser sleeve. The recess is greater in size than the lantern itself, and as

a consequence the lantern 5 can move in a radial direction relative to the work string, but within the limits set by the recesses in the upper centraliser and lower milling sleeves.

In the preferred embodiment the tool 1 also comprises a means for cleaning the well fluid within the well. The fluid cleaning means may comprise filtration equipment which may be provided in a variety of different embodiments. For example the filtration equipment may be a wire screen which is appropriately sized to prevent particles of debris from passing through the body 2. It will be appreciated that the filtration equipment could also be comprised of, for example, permeable textile or holed tubes or cages. By providing said filtration equipment the tool can filter debris particles from the well fluid.

The tool 1 may alternatively have a junk-sub 11 to collect debris from the wellbore as shown in Figure 3. In the embodiment shown, the junk sub 11 is positioned close to the milling sleeve 4 and scraper blades 6 and is hence used to collect debris which is liberated into the annulus of the casing or liner.

The advantage of the present invention is that the time taken for finishing a wellbore can be greatly reduced as there is no need to implement complex and timely retrieval operations to recover a milling or scraping apparatus from the bore prior to running the other of the milling or scraping component to the bore. As a consequence, profitable production can be begun much sooner. In particular, the tool of the present invention allows the liner top polished bore receptacle within a

wellbore to be "dressed off" at the same time as the casing above the liner top is scraped and cleaned. This allows the finished wellbore to be cleaned to remove obstructions such as burrs or lumps of cement, and to smooth entry into the liner top. In the present invention this combination of scraping and milling can be carried out at the same time, and any debris dislodged by said actions will be removed from the well fluid by the filtration equipment or junk sub. There is therefore no need to run a second fluid cleaning tool into the wellbore after milling and scraping.

In addition, as the scraping members are positioned in close proximity to the milling sleeve, it is possible to set up a packer very close to the polished bore receptacle, in order to isolate a section of the wellbore.

Further modifications and improvements may be incorporated without departing from the scope of the invention herein intended. For example, the scraper blades may be replaced with other cleaning members as are known in the art eg brushes.

CLAIMS

1. A downhole tool for mounting on a work string, the tool comprising an elongate body having a plurality of cleaning members, and wherein the tool also comprises means for milling casing or liner.

2. A downhole tool according to Claim 1 wherein the tool also comprises means for cleaning well fluid.

3. A downhole tool according to Claim 2 wherein said means for cleaning well fluid is a junk basket.

4. A downhole tool according to Claim 2 wherein said means for cleaning well fluid may be filtration equipment.

5. A downhole tool according to any preceding Claim wherein the cleaning members are scraper blades.

6. A downhole tool according to any preceding Claim wherein the tool has a first and second sleeve.

7. A downhole tool according to Claim 7 wherein the first sleeve is a centraliser sleeve and acts as a stabiliser for the work string within a wellbore.

8. A downhole tool according to Claim 6 or 7 wherein the second sleeve is a milling sleeve.

9. A downhole tool according to any one of Claims 6 to 8 wherein the tool has a floating component located between said first and second sleeve, the floating component is free to move in a radial direction

relative to the elongate body within predetermined limits set by the first and second sleeve.

10. A downhole tool according to Claim 9 wherein the first and second sleeve have female receiving means for receiving the floating component.

11. Claim 10 wherein the plurality of cleaning members are supported on the floating component.

12. A downhole tool according to any one of Claims 7 to 11 wherein the centraliser sleeve is mounted by ball bearings that allow for the work string to rotate relative to the sleeve.

13. A downhole tool according to any one of Claims 8 to 12 wherein the milling sleeve is mounted by one or more lock studs that lock the milling sleeve both axially and rotationally with respect to the elongate body.

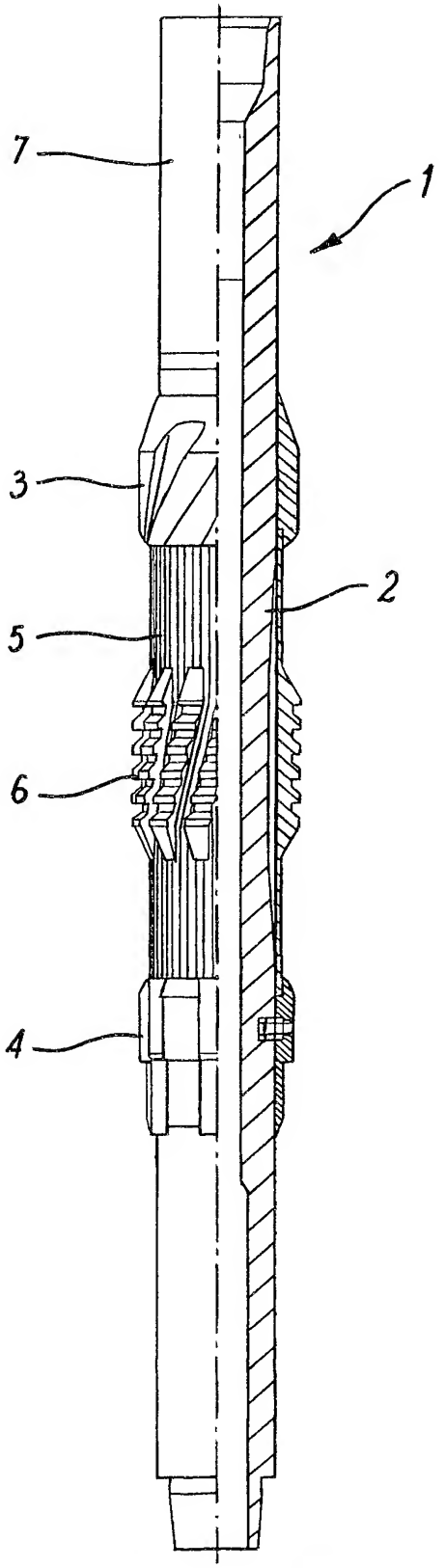
14. A method of cleaning and milling, casing or liner within a wellbore, the method comprising the steps:

a) locating in the wellbore a tool having cleaning members and a milling surface; and

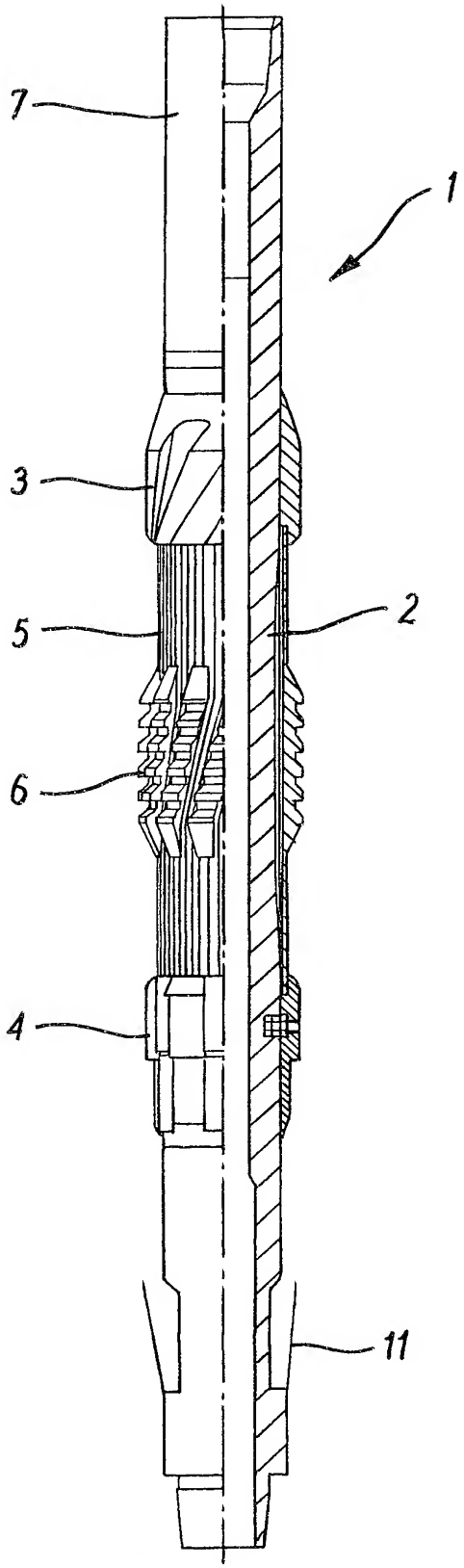
b) moving the tool relative to the casing or liner to effect the dual action of cleaning and milling.

15. The method of Claim 14 including the step of cleaning well fluid in the wellbore.

16. The method of Claim 14 or Claim 15 including the step of collecting debris during the cleaning and milling action.



Фиг. 1



Фиг. 3

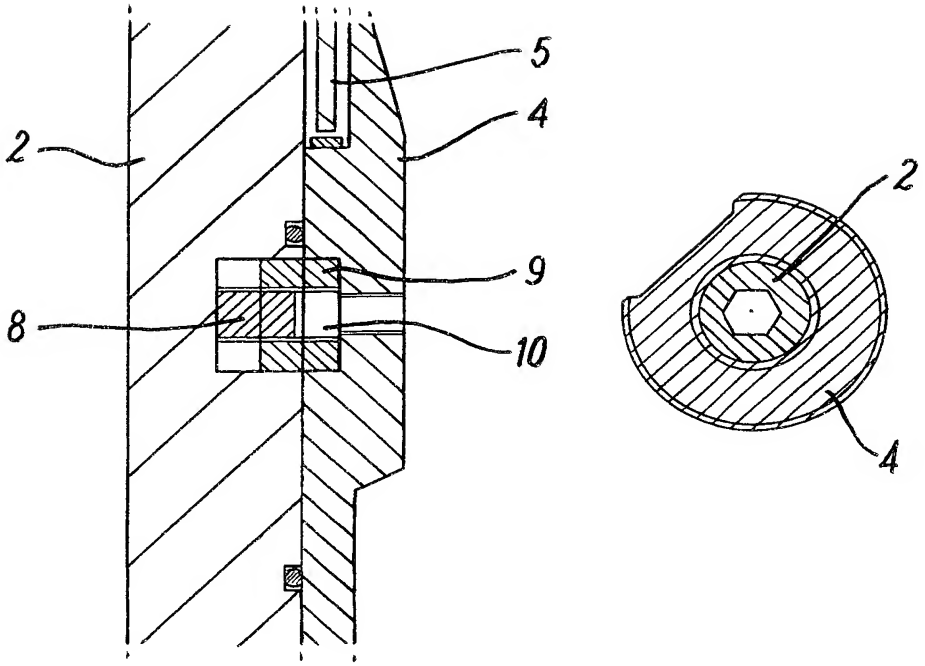


FIG. 2

INTERNATIONAL SEARCH REPORT

Intern al Application No
PCT/GB 01/04742

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 E21B37/02 E21B27/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 00 58602 A (FRENCH CLIVE JOHN ;FRENCH OILFIELD SERVICES LTD (BE)) 5 October 2000 (2000-10-05)	1-8, 14-16
Y	page 11, line 3-20 page 16, line 18 -page 22, line 15; figures 1-9 page 13, line 17- -page 14, line 13 ---	9-13
Y	GB 2 340 862 A (SPECIALISED PETROLEUM SERV LTD) 1 March 2000 (2000-03-01) page 8, line 10-29; figures 1-7 ---	9-12
P,Y	WO 01 63087 A (EDDISON ALAN MARTYN ;ANDERGAUGE LTD (GB)) 30 August 2001 (2001-08-30) page 8, line 8-18; figures 1-3 ---	13
	-/--	

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 February 2002	07/03/2002

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel (+31–70) 340-2040, Tx. 31 651 epo nl, Fax: (+31–70) 340-3016	van Berlo, A

Form PCT/ISA/210 (second sheet) (July 1992)

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 798 246 A (BEST DAVID M) 17 January 1989 (1989-01-17) figure 9	13
A	US 4 603 739 A (KRUGH MICHAEL E) 5 August 1986 (1986-08-05) figures 1-6	1
A	WO 98 35131 A (TELFER GEORGE ;LUCAS BRIAN RONALD (GB); WEATHERFORD LAMB (US)) 13 August 1998 (1998-08-13) figure 13	1
A	US 3 199 599 A (KAMMERER JR ARCHER W) 10 August 1965 (1965-08-10) figures 1-3	13
A	US 4 189 000 A (BEST DAVID M) 19 February 1980 (1980-02-19) figures 1-4	13

INTERNATIONAL SEARCH REPORT

Information on patent family members

Interna ıl Application No
PCT/GB 01/04742

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 0058602 A	05-10-2000	AU 3974400 A	16-10-2000
		EP 1165935 A1	02-01-2002
		WO 0058602 A1	05-10-2000
GB 2340862 A	01-03-2000	NO 993998 A	22-02-2000
		US 6152220 A	28-11-2000
WO 0163087 A	30-08-2001	AU 3396101 A	03-09-2001
		WO 0163087 A1	30-08-2001
US 4798246 A	17-01-1989	NONE	
US 4603739 A	05-08-1986	US 4515212 A	07-05-1985
WO 9835131 A	13-08-1998	AU 730038 B2	22-02-2001
		AU 5671498 A	26-08-1998
		EP 0960263 A2	01-12-1999
		WO 9835131 A2	13-08-1998
		NO 993500 A	04-10-1999
US 3199599 A	10-08-1965	NONE	
US 4189000 A	19-02-1980	NONE	